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(12) # EUROPEAN PATENT APPLICATION

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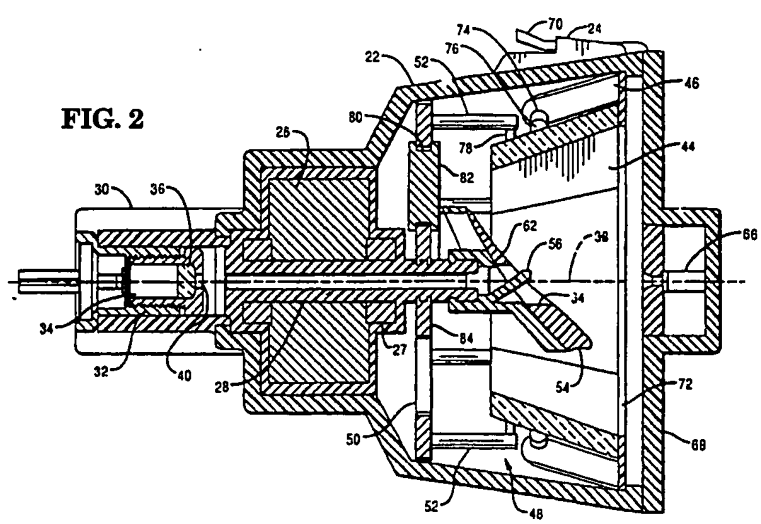
(54) **Optical scanning apparatus.**

(57) An optical scanning unit for scanning a bar code (60) includes a plurality of pivotably mounted pattern forming mirrors (44). A laser beam is projected along a hollow rotatable drive shaft (28) and is deflected by a plane mirror (56) secured to the drive shaft (28) to scan the beam over the pattern forming mirrors (44). Each of the pattern forming mirrors (44) includes a cam portion (78) which is engaged by a roll member (52) driven by a ring member (50) which in turn is rotated by the drive shaft (28). The unit generates a plurality of successively larger scan patterns, after which biasing members (86) return the mirrors (44) to their home position.

FIG. 2



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OPTICAL SCANNING APPARATUS

This invention relates to optical scanning apparatus of the kind for projecting scanning beams at coded indicia, including a source of scanning light beam, directing means adapted to direct the scanning light beams along a first light path, and deflecting means mounted in said first light path and adapted to deflect the light beams along a plurality of second light paths.

In present-day merchandising point-of-sale checkout systems, data pertaining to the purchase of a merchandise item is obtained by reading data encoded indicia such as a bar code label printed on or attached to the purchased merchandise item. Reading systems which have been constructed to read this type of bar code include stationary optical scanning systems normally located within the cabinet structure of a checkout counter or hand-held laser scanners which emit a single or multiple line scan pattern. However, it has been found that the known scanning systems, particularly hand-held scanners, have the disadvantage that it is difficult to achieve efficient scanning of different size coded indicia.

It is an object of the present invention to provide a simple, low-cost optical scanning apparatus of the kind specified, whereby efficient scanning of different size coded indicia may be achieved.

Therefore, according to the present invention, there is provided optical scanning apparatus off the kind specified, characterized by:
pivotably mounted reflecting means mounted in each of said second light paths and adapted to reflect the light beams along a third light path adapted to scan coded indicia, the third light paths forming a first scanning pattern; and actuating means adapted to engage each of said reflecting means for pivoting each of said reflecting means with respect to said second light paths enabling the reflecting means to reflect the light beams along a plurality of fourth light paths forming a second scanning pattern for scanning the coded indicia.

It will be appreciated that, in apparatus according to the invention, the provision of a second scanning pattem facilitates the scanning of different size coded indicia.

One embodiment of the present invention will now be described by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is an exploded view of a scanning unit which incorporates the present invention showing the elements which generate a plurality of scanning patterns;

Fig. 2 is a sectional side view of the scanning unit shown in Fig. 1;

Fig. 3 is a perspective rear view of the pattern mirror assembly showing details of the mirror actuating mechanism and the scanning unit drive mechanism;

Fig. 4 is a side view of the pattern mirror assembly shown in Fig. 3;

Fig. 5 is a partial detailed view of the pivot mechanism of the pattern mirrors; and

Fig. 6 is a plan view of the scan patterns for scanning a coded label generated by the present invention.

Referring now to Fig. 1, there is shown an exploded view of a scanning unit incorporating the present invention which may be mounted in a hand-held scanner. While the present invention is shown mounted in a hand-held optical scanner, it is obvious that the present invention may be employed with any type of optical scanning unit which utilizes pattern mirrors for generating a scan pattern.

As shown in Fig. 1 and in Fig. 2, which is a cross sectional view of the scanning unit, the scanning unit 20 includes a molded frame support member 22 having a plurality of latching portions 24. The frame support member 22 may be molded of any type of shock resistant plastic material such as polycarbonate. Mounted within the support member 22 is a motor 26. Journaled within the motor by bearings 27 (Fig. 2) is a hollow drive shaft 28 extending through the motor 26. Mounted within a rear extension portion 30 of the frame support member 22 is a brass laser diode member 32 supporting a laser diode 34 (Fig. 2) and a collimating and focusing lens member 36 both of which are in alignment with the spin axis 38 (Fig. 2) of the drive shaft 28. The diode 34 outputs a diverging light beam which is collimated and focused on a reference plane (not shown) in front of the scanning unit by the lens member 36. A circular aperture stop 40 (Fig. 2) positioned adjacent the lens member 36 has a cross-section which is smaller than the lens member 36 for controlling the size of the laser light beam projected at the reference plane in a manner that is well known in the art.

Mounted within the frame support member 22 is a pattern mirror assembly generally indicated by the numeral 42 (Fig. 1) which includes a plurality of pattern mirror members 44 each of which is rotatably mounted on an arm member 46 for movement in a counterclockwise direction as viewed in Fig. 2 to vary the angle of the mirrors with respect to the spin axis 38 of drive shaft 28. The mirror members 44 are operated by a drive mechanism generally indicated by the numeral 48 (Figs. 1 and 2) which includes a rotating ring member 50 on

which are mounted a plurality of roll members 52 each of which engages an associated mirror member 44 to rotate the mirror member in a manner that will be described more fully hereinafter.

Secured to the front end of the drive shaft 28 is an optical transceiver 54 comprising a flat deflecting mirror portion 56 which, as shown in Fig. 2, extends obliquely across the spin axis 38 to deflect the laser light beam projected along the spin axis towards the pattern mirror members 44 which deflect the light beams in the form of a scan pattern 58 (Fig. 6) for scanning a coded label 60. The transceiver 54 further includes a collection mirror portion 62 for collecting the scanning light beams reflected from the scanned coded label 60. As seen in Figs. 1 and 2, the deflecting mirror portion 56 extends through an aperture 64 in the collection mirror portion 62 of the transceiver 54.

The collection mirror portion 62 will deflect the collected light beams towards a photodetector member 66 mounted within a transparent support member 68 (Figs. 1 and 2) having a plurality of flexible finger members 70 which snap over the latching portions 24 of the frame support member 22 for securing the support member 68 to the support member 22.

Referring now to Figs. 2-5 inclusive, there are shown views and details of the pattern mirror assembly 42 (Fig. 1) which includes a disk- shaped support member 72 snapped into the front portion of the frame support member 22 (Fig. 2). The support member 72 has mounted thereto the arm members 46, to each of which is rotatably mounted, within an aperture 74 in the arm member 46, one end of a curved stud member 76 whose other end is molded to one side of an associated pattern mirror member 44. As seen from Figs. 3 and 4, each mirror member 44 has two stud members 76 molded to opposite sides of the mirror member each of which is rotatably secured to adjacent arm members 46.

Molded adjacent the rear edge of each mirror member 44 is a wedge or cam portion 78 which slopes in an upward direction from one edge to the opposite edge of the mirror member 44 when moving in the direction of the arrow on the ring member 50 (Fig. 3). Engaging the cam portion 78 of each mirror member 44 is one of the roll members 52 (Figs. 1-5 inclusive) secured to the ring member 50. As best seen in Figs. 2 and 3, - the ring member 50 has located around the periphery of its inner edge a plurality of gear teeth 80 which engage a gear member 82 which in turn engages a gear member 84 secured to the drive shaft 28.

Clockwise rotation of the drive shaft 28 results in the rotation of the ring member 50 in the direction illustrated by the arrow in Fig.3. This rotation of the ring member 50 which is slower than that of the drive shaft 28 will move each of the roll members 52 along the cam portion 78 of its associated mirror member 44. As seen in Fig. 5, movement of the roll member 52 along the cam portion 78 will cam the mirror member 44 counterclockwise about the end of the stud member 76 mounted in the arm member 74 to the position shown in dotted lines. This changes the angle of the mirror member 44 in relation to the transceiver 54 which increases the angle of incidence of the light beams striking the mirror member. When this occurs, the scanning light beams deflected by the transceiver 54 will strike each pattern mirror member 44 "n" times before the mirror members return to their home position. This action creates "n" individual scan lines at different points in space for each individual mirror member. As the mirror members are rotated counterclockwise around an axis which is perpendicular to the path of the light beams striking the mirror members during one revolution of the drive shaft 28, the scan pattern increases outwardly in a circular fashion as shown in Fig. 6. This will continue until the roller members 52 reach the end of the cam portion 78 of the mirror members 44 at which time they will release the mirror members to return to their home positions, in the manner described hereinafter. It will thus be seen that as the drive shaft 28 rotates, the rotation of the ring member 50 results in each of the mirror members 44 being engaged by each of the roller members 52 generating a fluctuating scan pattern during the scanning of the bar code label.

The counterclockwise rotational movement of each of the mirror members 44 is resisted by a flexible arm member 86 (Figs. 3 and 4) secured to the support member 72 and having its free end engaging the mirror member 44. The action of the arm member 86 will bias the cam portion 78 of the mirror member into engagement with the roll member 52 providing a continuous rotational movement of the mirror members 44 during operation of the scanning unit. The arm member 86 will also return its associated mirror member to its home position at the completion of the engagement of the roll member 52 on the cam portion 78 prior to the engagement of the next roll member 52 with the cam portion 78.

As seen in Fig. 6, the mirror members 44 will initially generate the scan pattern 58, when in their home positions onto the coded label 60. As previously described, the mirror members 44 will be rotated outwardly during a single revolution of the drive shaft 28 producing a series of ever larger scan patterns 88 until the scan pattern reaches a maximum size 90 thus increasing the density and the scan area of the scan pattern. It will thus be seen that during operation of the scanning unit 20, the pattern mirror members 44 will cyclically gen-

erate the scan patterns 58, 88 and 90.

There are three factors that control the size and density of the scan pattern generated by the present invention:

(1) The slope of the cam portion 78 of the mirror members 44. Increasing the slope of the cam portion 78 increases the angle of incidence of the scanning light beam on the mirror member causing the light beam to be deflected more away from the center of the mirror member.

(2) The initial setting of the mirror members 44 will determine the density of the scan pattern when the mirror members are in a home position.

(3) The rotational speed of the drive shaft 28 with respect to the rotational speed of the ring member 50. The higher the ratio of these two speeds, the greater the density of the scan pattern.

It will be seen that the pivoting action of the mirror members enables each mirror member to become more efficient in producing the number of scan lines that make up the scan pattern. By changing the three variables: degree of angle change, speed of the drive shaft 28 and speed of the ring member 50, the density and size of the scan pattern can be changed. For example, with no pivoting mirror members, a 152 millimetres (6 inch) diameter circle would be covered. With the pivoting mirror members, that diameter may be expanded up to 457 millimetres (18 inches).

Claims

1. Apparatus for projecting scanning beams at coded indicia, including a source (34) of scanning light beams, directing means (28,36,40) adapted to direct the scanning light beams along a first light path, and deflecting means (56) mounted in said first light path and adapted to deflect the light beams along a plurality of second light paths, characterized by: pivotably mounted reflecting means (44) mounted in each of said second light paths and adapted to scan coded indicia, (60) the third light paths forming a first scanning pattern (58); and actuating means (50,52,80,82,84) adapted to engage each of said reflecting means (44) for pivoting each of said reflecting means (44) with respect to said second light paths enabling the reflecting means (44) to reflect the light beams along a plurality of fourth light paths forming a second scanning pattern (90) for scanning the coded indicia(60).

2. Apparatus according to claim 1, characterized in that said reflecting means includes mirror means (44) mounted for pivoting about an axis perpendicular to said second light paths, said mirror means (44) including a cam portion (78) extending from a surface of the mirror means (44) and said actuating means (50,52,80,82,84) including at least one actuating member (52) engaging said cam portion (78) and adapted for movement along said cam portion (78) to pivot the mirror means (44) with respect to said second light paths to reflect the light beams along said fourth light paths.

3. Apparatus according to claim 2, characterized in that said directing means includes a rotatable drive member (28), said actuating means including a first support member (50) operatively connected to said drive member (28) and secured to said at least one actuating member (52) and adapted for movement upon rotation of said drive member (28) whereby said at least one actuating member (52) is moved along said cam portion (78) to pivot the mirror means (44).

4. Apparatus according to claim 3, characterized by biasing means (86) engaging the mirror means (44) and adapted to bias the mirror means (44) in a direction opposite to the movement of the mirror means (44) by said at least one actuating member (52).

5. Apparatus according to claim 4, characterized in that said first support member comprises a ring member (50) on which is mounted said at least one actuating member (52), said actuating means (50,52,80,82,84) further including gear means (82,84) secured to said drive member (28) and engaging said ring member (50) for rotating the ring member (50) in response to rotation of the drive member (28).

6. Apparatus according to claim 5, characterized by a plurality of second support members (46) positioned adjacent said mirror means (44) and a plurality of third support members (76) mounted in said second support members (46) thereby pivotably mounting said mirror means (44).

7. Apparatus according to claim 6, characterized in that the rotation of the ring member (50) results in the pivoting of the mirror means (44) to an actuated position forming said second scanning pattern, said biasing means (86) subsequently returning the mirror means (44) to their home position.

8. Apparatus according to claim 7, characterized in that the size of said second sensing pattern (90) is greater than the size of said scanning pattern (58), and wherein said mirror means (44) produce a plurality of third scanning patterns (88) during movement to said actuated position, each of said third scanning patterns (88) being successively larger than the previous third scanning pattern (86), but smaller than said second scanning pattern (90).

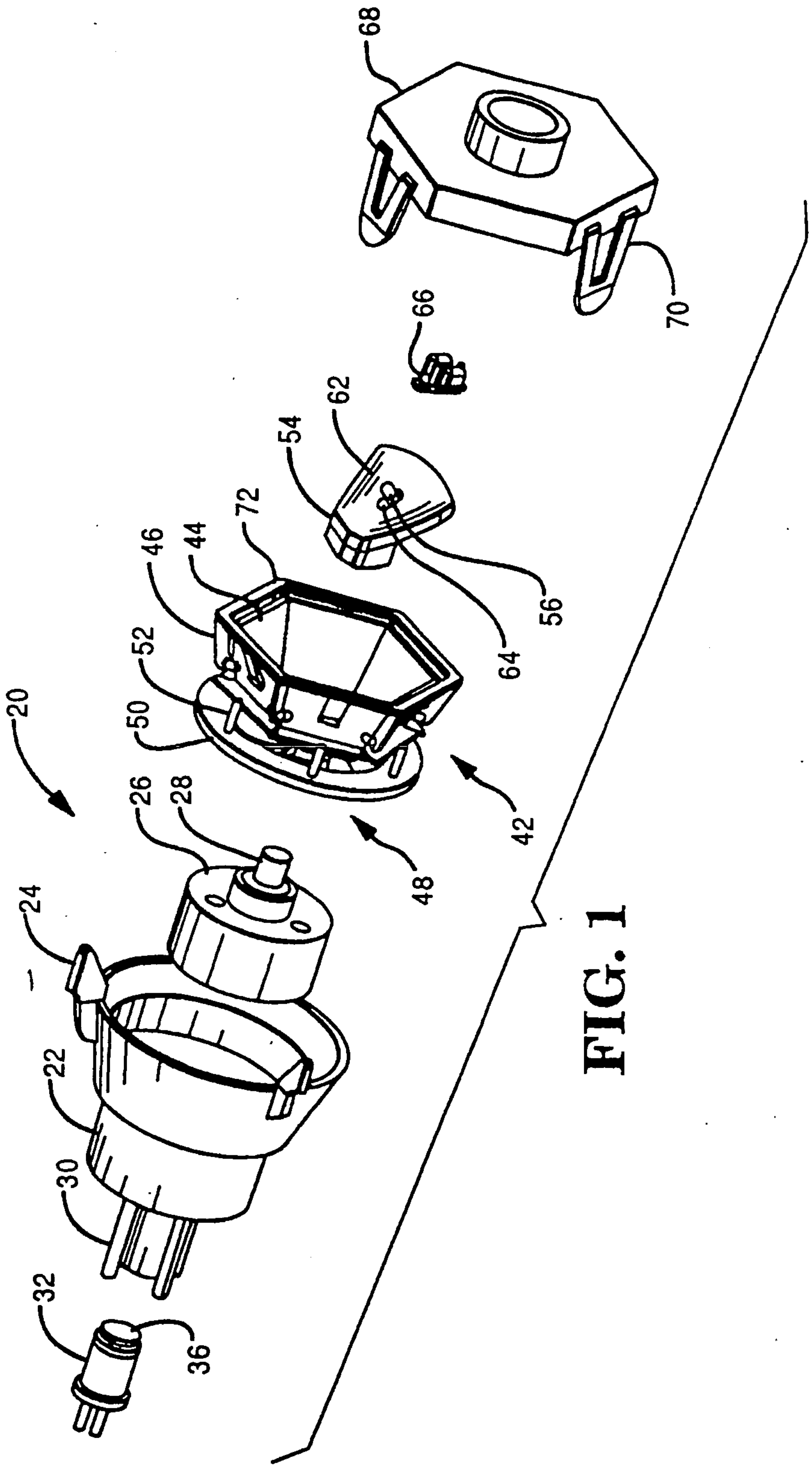

FIG. 1

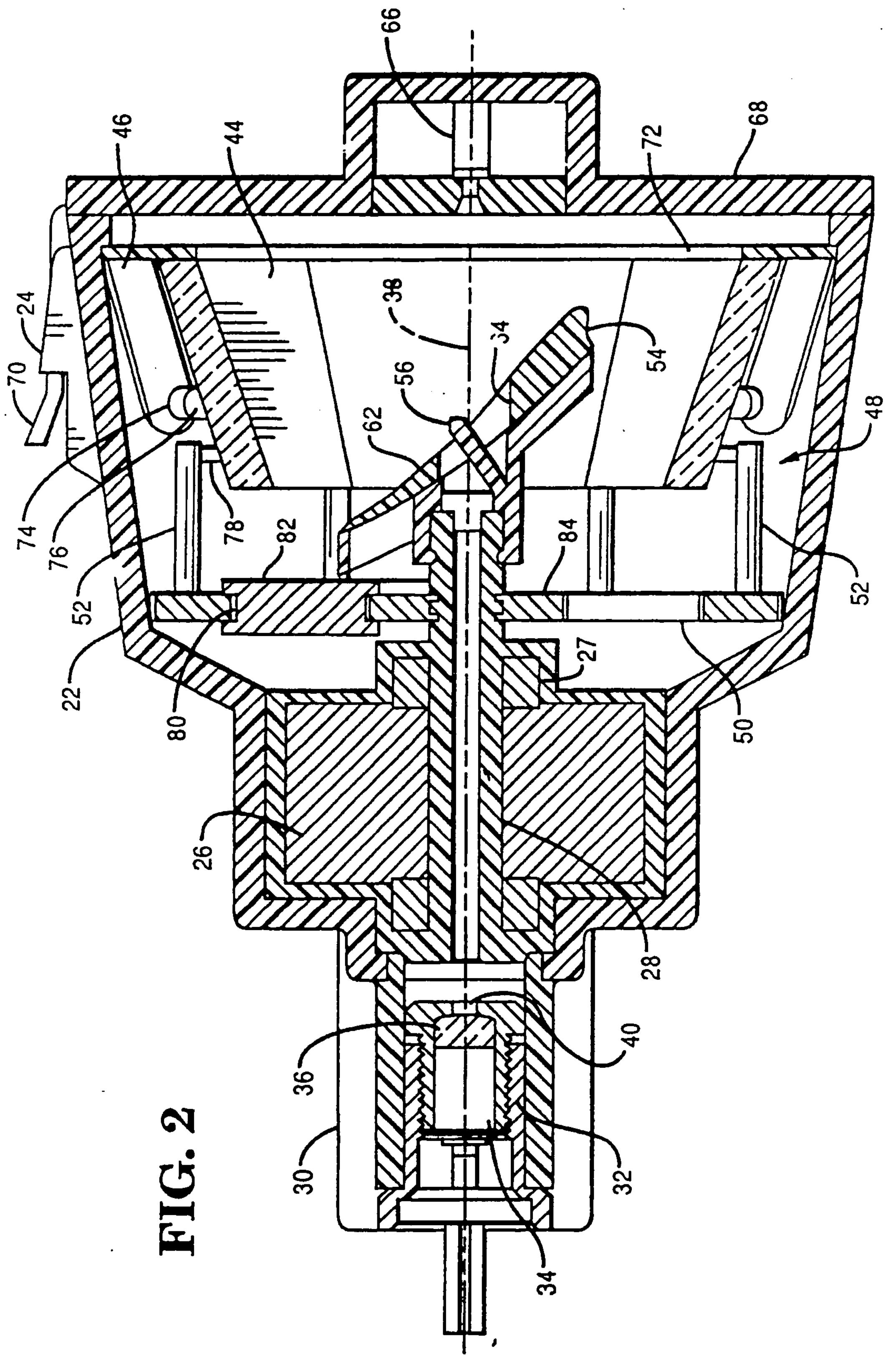
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FIG. 2

FIG. 3

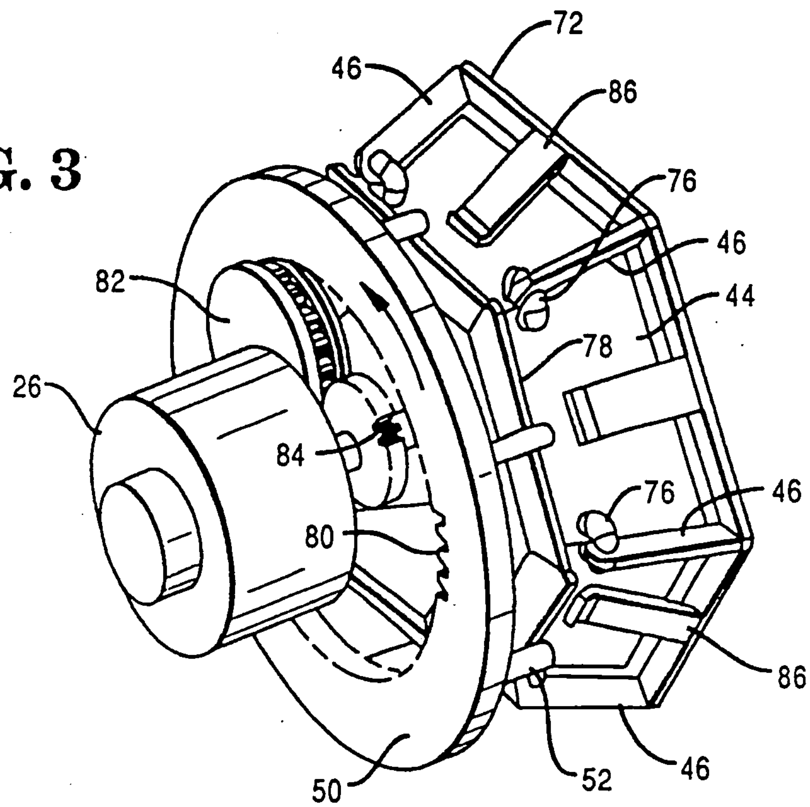
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FIG. 4

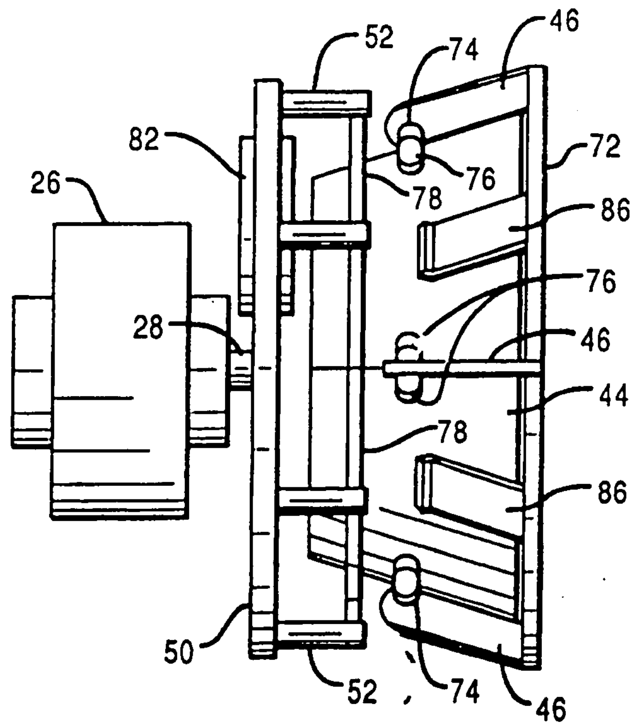
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FIG. 5

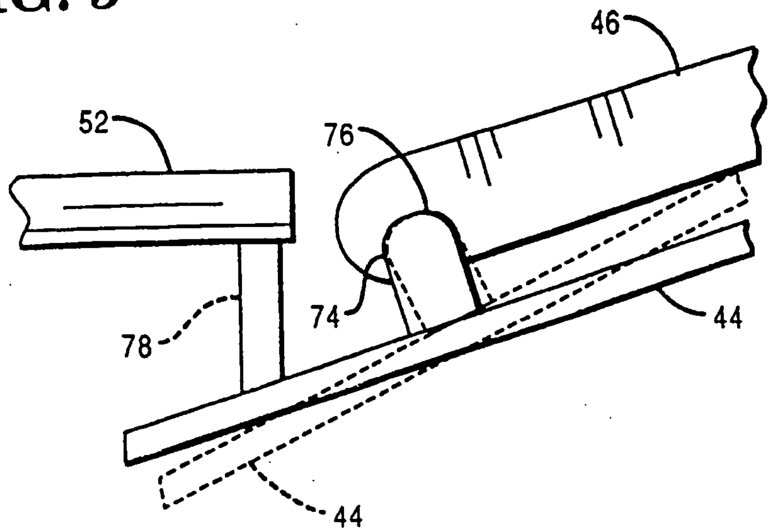
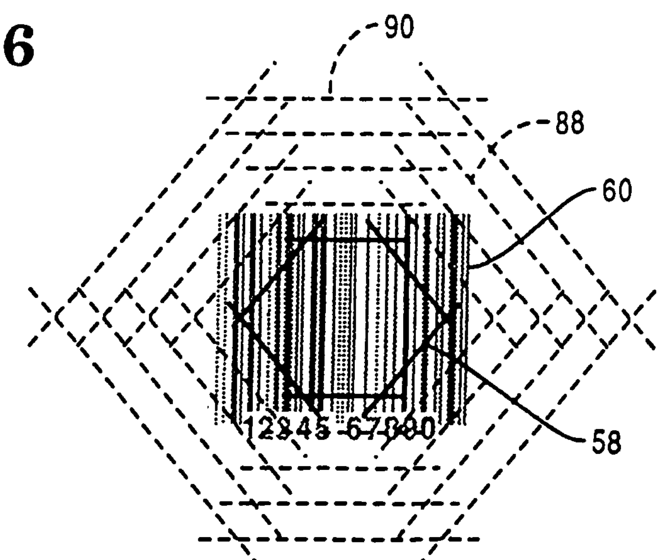


FIG. 6



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EUROPEAN SEARCH REPORT

Application Number

EP 90 31 2959

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X,A	US-A-4 699 447 (P.G.HOWARD) * abstract; figures 2, 4, 5, 7, 8 * * column 1, lines 13 - 15 * * column 2, lines 5 - 37 * ---	1,2	G 06 K 7/10 G 02 B 26/10
A	US-A-4 795 224 (K.GOTO) * abstract; figures 2, 4 * * column 3, lines 9 - 68 @ column 6, line 61 - column 7, line 4 @ column 9, lines 37 - 42 * ---	1,3,5,7,8	
A	EP-A-0 032 794 (FUJITSU) * abstract; figures 5, 7, 11-19 * ---	1,3,5,8	
A	EP-A-0 273 554 (SYMBOL TECHNOLOGIES) * abstract; figures 7, 9 * ---	1,3,5	
A	EP-A-0 323 026 (SYMBOL TECHNOLOGIES) * abstract; figures 1, 12, 13 * ---	1,8	
A	DE-A-3 202 820 (SHARP) * abstract; figures 15, 13, 14 * -----	1,8	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
G 06 K G 02 B

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
Berlin	05 March 91	FRITZ S C

CATEGORY OF CITED DOCUMENTS

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